

APPENDIX A

Training Materials

This appendix provides most of the 93 slides presented in the one-day Investigating Officer training conducted at participating Marine Safety Offices. The slides showing completed forms are omitted.

Communications in Casualty Investigations

Investigation and Reporting Procedures



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Project Team

U.S. Coast Guard R & D

- Myriam Smith, Human Factors Research Scientist
- Anita Rothblum, Human Factors Research Scientist

Battelle

- Marvin McCallum, Senior Research Scientist
- Mireille Raby, Research Scientist

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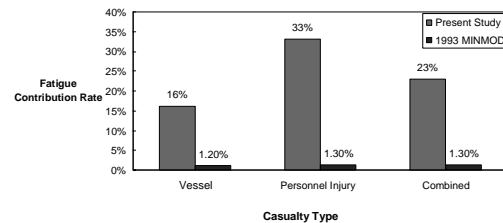
Project Background

- USCG has great potential for determining human factors role in casualties
- USCG R&D fatigue investigation project (pilot study - 1996)

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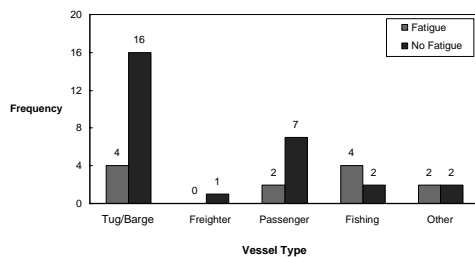
Fatigue Study Results: Level of Fatigue Contribution



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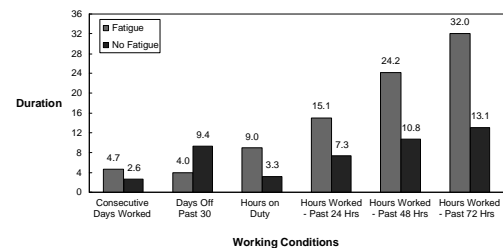
Fatigue Study Results: Vessel Casualty Industry Segments



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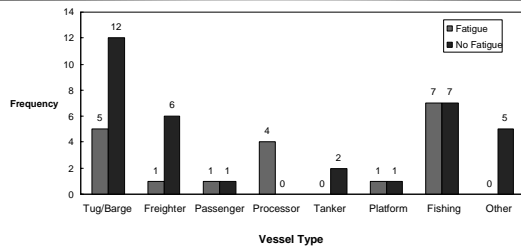
Fatigue Study Results: Vessel Casualty Working Conditions



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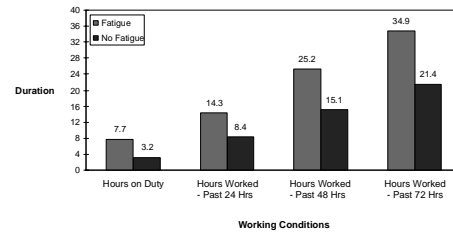
Fatigue Study Result: Personnel Injury Industry Segments



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Fatigue Study Results: Personnel Injury Working Conditions



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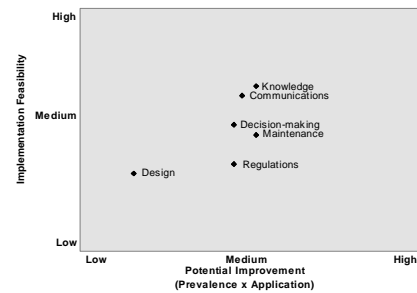
Program Objectives

1. Enhance investigation of human factors in marine casualties.
2. Develop and implement single human factor topic investigation and reporting procedures.
3. Evaluate procedures usability, value of data, and applicability of methods.
4. Support *Prevention Through People*.

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Result of Human Factors Topic Assessment



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Communications Investigation Goals

- Determine extent of communications contribution to marine casualties.
- Identify trends in role of communications breakdowns in maritime industry.
- Increase maritime safety by identifying operational practices that contribute to communications breakdowns and casualties.

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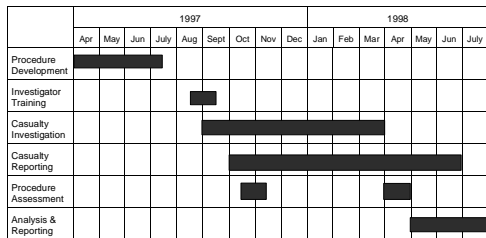
Project Plan

1. Develop investigation procedures and forms.
2. Train Investigators at selected MSOs.
3. Assess and modify procedures.
4. Continue investigation for 6-8 months.
5. Obtain final MSO feedback.
6. Analyze data and report findings.

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Project Overview



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Today's Training Schedule

- Morning
 - » Project background & training objectives
 - » Human factors & human error concepts
 - » Communications concepts
 - » Investigation & reporting procedures
- Afternoon
 - » Case scenarios
 - » Wrap-up

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Training Objectives

1. Develop general understanding of:
 - project goals
 - human factors concepts
 - human errors in casualties
 - communications process problems & contributing factors
2. Become familiar with communications investigation & reporting procedures

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What is Human Factors?

Multi-disciplinary approach to the study of human abilities and limitations and how characteristics of *machines* and of the *environment* (physical, organizational) interact to affect *human* performance.

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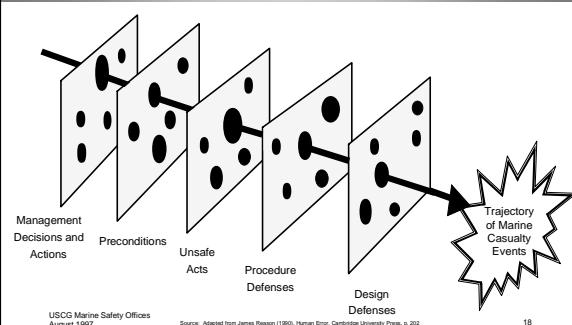
Human Factors Perspective to Casualty Investigation

- Human capabilities & limitations?
- Human performance in operating & maintaining equipment or system?
- Operating conditions under which humans act?
- Environmental conditions in which humans operate?

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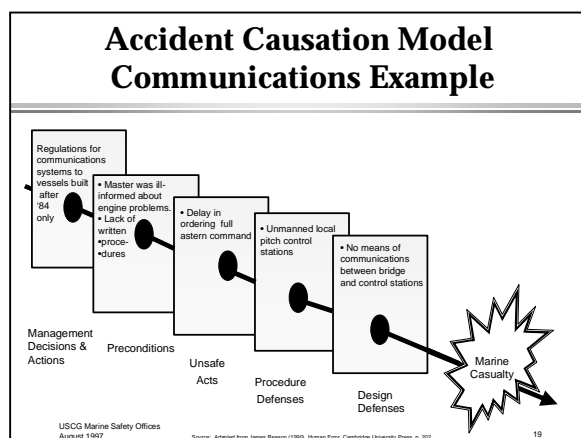
Factors Contributing to Marine Casualties



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Source: Adapted from James Reason (1980), *Human Error*, Cambridge University Press, p. 302

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Unsafe Acts - Unsafe Conditions

<u>Unsafe Acts</u>	<u>Unsafe Conditions</u>
<ul style="list-style-type: none"> • acting without proper authority • failure to warn or secure • operating at improper speed • using defective equipment • using equipment improperly • failure to use personal protective equipment • improper loading or lifting 	<ul style="list-style-type: none"> • inadequate guards or protection • defective tools, equipment, substances • congestion • inadequate warning system • fire and explosion hazards • excessive noise • inadequate illumination

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Unsafe Actions & Errors

- In hindsight a human action/inaction is labeled an error.
- Errors are unplanned, unintentional, and represent inappropriate actions in a given set of circumstances.
- Contributing factors to errors and consequences of errors are the important factors to study.
- Only errors which have the greatest potential for reducing safety & system effectiveness, and factors contributing to these errors, should be investigated.

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Human Error Classifications

Commission Errors inappropriate action e.g., while fighting fire, crewmember turns the fuel pump to 'on' rather than 'off'	Omission Errors absence of a required action e.g., while fighting fire, crewmember forgets to mention that fuel pump is 'on'
Slip correct intention, but inappropriate action e.g., switched radar 'off' rather than 'on'	Mistake inappropriate intention e.g., maintained full speed in narrow channel despite traffic

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Error Remediation

Human errors can be reduced by addressing:

1. Task design.....lower mistakes
2. Equipment design.....lower slips
3. Traininglower slips &/or mistakes
4. Assists & Rules.....lower mode violations
5. Error-tolerant systems.....attempts to avoid irreversible actions

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Why Communications?

- One of 10 critical human factors contributions to marine casualties identified by *Prevention Through People QAT*.
- Ranked 2nd priority in assessment of potential investigation topics.
- Lack of reliable data; estimates of contribution range from 15-40%.

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Prevalence of Communications Factors in Maritime Casualties

- NTSB: 'Inadequate communication/coordination' was identified as contributing to 44 of 215 (20.5%) casualties
- Between 1981 and 1992, the TSB investigated 273 occurrences involving vessels in Canadian Pilotage waters, under the conduct of a pilot. Of these, 200 had human factors as the most significant contributing factor:
 - » 10% due to lack of communication
 - » 8.5% due to misunderstanding
 - » 45.5% misjudgment of pilot or master
 - » 23.5% inattention of pilot or OOW
 - » 12.5% other human factors.

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What Do We Mean by Communications?

- Process by which information is exchanged between individuals through a common system of symbols, signs, or behavior.
- A system (e.g., telephones, walkie-talkies, PA system) for communicating
- Written communications (e.g., standing orders, notes, faxes)

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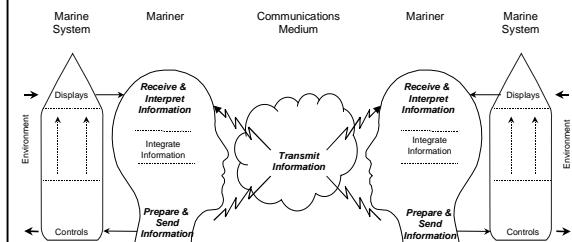
Basic Facts about Safety Communications

- "A communication requires feedback.
- Communications are not all good, even when they are well-intentioned.
- Communications may not be well presented.
- Communications tend to be distorted in proportion to the number of channels they must pass through.
- The greater the number of communication channels being used at any one time, the greater the probability of a communications breakdown.
- Noise level impairs communications."

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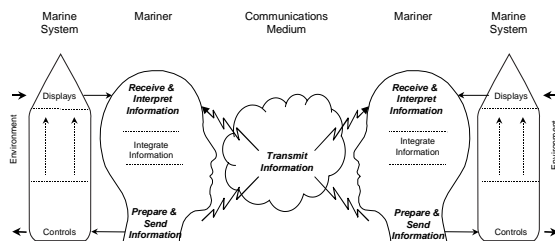
Marine Communications Model



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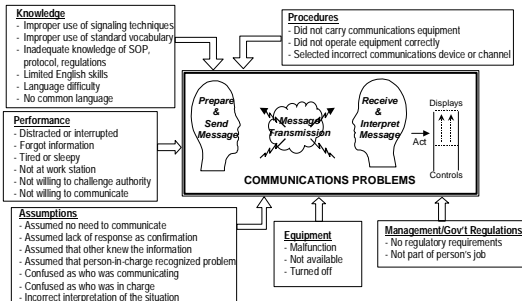
Marine Communications Model



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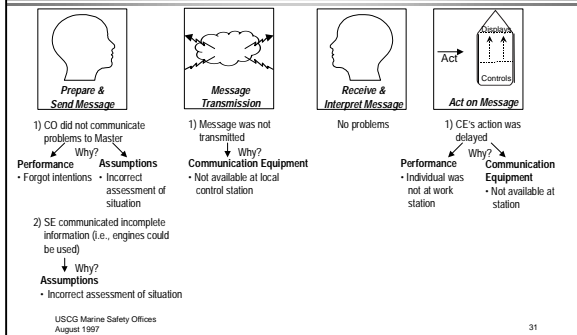
Contributing Factors to Communications Problems



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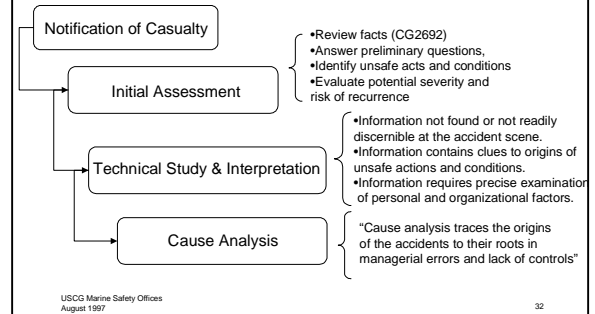
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Communications Concepts Applied to a Casualty Case



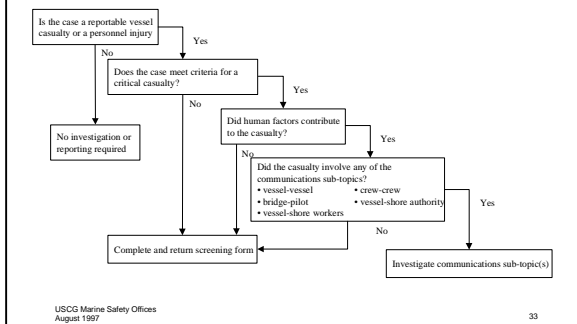
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General Investigation Process



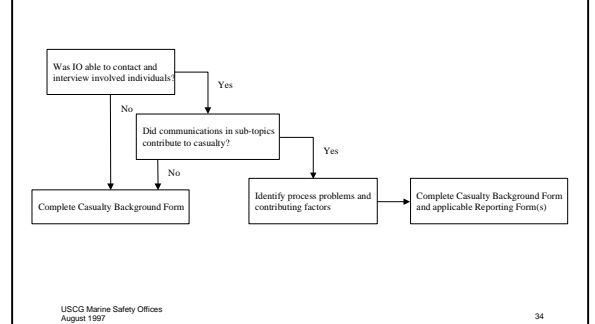
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Overview of Communications Investigation and Reporting Process



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Overview of Communications Subtopic Investigation & Reporting



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Investigation and Reporting Forms

1. Casualty Screening Form

- » Criticality of Casualty
- » Human factors involvement
- » Communications Sub-topic

2. Casualty Background Form

- » Reference information
- » Basic casualty information
- » Individuals involved

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Investigation & Reporting Forms, cont.

3. Communications Reporting Forms

- » Set of five sub-topic forms
 - Vessel - Vessel
 - Bridge - Pilot
 - Crew - Crew
 - Vessel - Shore Authority
 - Vessel - Shore Workers
- » Content
 - Reference information
 - Individuals contacted
 - Specific communications contribution
 - Communications analysis
 - Conclusions and comments

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Casualty Screening Form

Insert blank form

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Casualty Background Form

Insert blank form

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Communications Reporting Forms

Insert blank forms

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CASE 1 — Engine Failure on board a Cruise Ship

Summary:

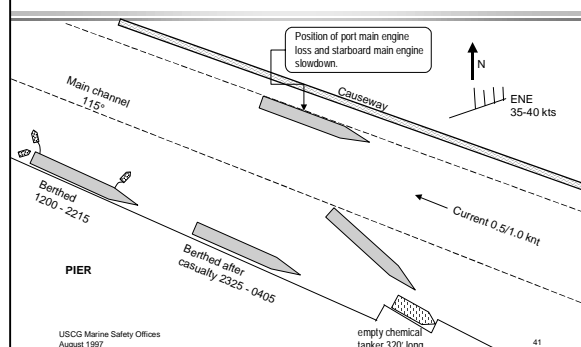
Shortly after departing port at 2242, the *MS Funship's* port main engine stopped. While maneuvering against the wind (ENE 35-40 knots), with the assistance of 3 tug boats, contact was made with a moored empty chemical tanker.

» Limited damage, no deaths or injuries, no pollution.

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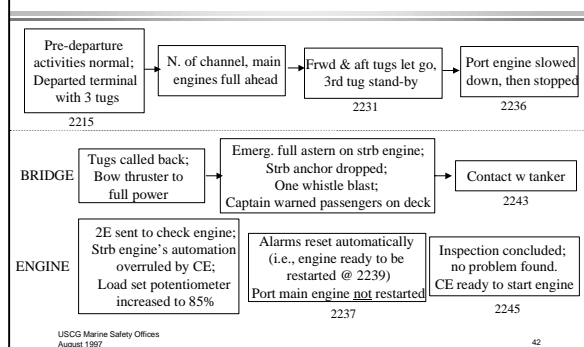
CASE 1 — Sketch of the Area



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CASE 1 — Factual Events



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CASE 1 — Communications

Communicated

- Bridge - 3O reported slowdown of port engine to captain and CO.
- Captain asked pilot to recall tugs. Pilot ordered tugs to position on port side and one on stbd side.
 - Captain ordered emergency full astern and anchor to be dropped. CO double rang engine order telegraph while 3O called ECR.
 - Captain ordered a whistle blast to warn tanker & shouted from wing to warn passengers of immediate danger.
- Engine - CE told 3O to be careful to not overspeed stbd engine.
- CE told 2E to check port main engine; 2E came back & indicated there appeared to be no problem.
 - CE told 2E to inspect thrust bearing.
 - CE pressed call button for additional assistance.
 - 2E told CE that visual inspection was completed & no problems.

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CASE 1 — Communications, cont.

Not Communicated

- Bridge - Captain did not call CE to tell him that he needed the port engine back a.s.a.p.
- Captain believed CE knew this was an emergency.
 - Captain believed that due to vessel's recent history of loss of propulsion, that CE understood that when an engine was lost while in restricted waters it was to be given back a.s.a.p.
 - Captain did not want to interrupt CE who was busy.
- Engine - CE did not call captain to tell him that the port engine could be used after all the alarms had reset.
- CE did not tell captain that he chose not to start port main engine until the thrust bearing was visually examined.

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CASE 1 — Forms to Complete?

- Casualty Screening Form --> Yes
- Casualty Background Form --> Yes
- Casualty Reporting Forms
- » vessel-vessel --> Yes
 - » bridge-pilot --> Yes
 - » crew-crew --> Yes
 - » vessel-shore authority --> No
 - » vessel-shore workers --> No

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CASE 1 — Screening Form

Insert completed form

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CASE 1 — Casualty Background

Insert completed form

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CASE 1 — Vessel-Vessel Form, Side 1 only

Insert completed form, Side 1 and leave notes here

- This is the first of the *Communications Reporting Forms* that has to be completed, as identified in Section 3 of the *Casualty Screening Form*.
- Section 1, is for the most part, similar to the previous ones. Again, you'll write your name, MSO and case number. The difference is that we ask you for some quality control data. We need to have the date that this form was completed. We also need you to indicate how much time was spent investigating communications-related factors only. Not the entire time you spent investigating this casualty, but rather the additional time you had to spend to collect the communications-related information, that you might not have done if you were not participating in this project. In item #6 you indicate how much time was spent completing all of these forms.
- Section 2 is very similar to Section 3 of the *Casualty Background Form*. In this section we ask that you identify the individuals you called or talked to in order to investigate the communications-related information. For each individual contacted, we ask that you indicate: 1) their name, 2) the number of calls made, and 3) to the best of your capabilities, the individual's fluency in the English language. We have provided some definitions in the instructions of what the 4 categories are. Let us review them. (Read instructions).
- Section 3 is the beginning of the communications-related reporting process. In this section, we ask that you look at the vessel-vessel communications only, that is were communications between the two vessels required or advisable, and if so, how were they conducted and were they a contributing factor to this casualty. What you answer in this section 3 will influence whether you complete section 5 or not. Let us review each item. Item #16 requires that you indicate whether communications between vessels were advisable. In this casualty they were in order to inform the tanker crew of the imminent danger. So, we checked 'yes' and wrote the purpose. Item #17 asks that you describe how these vessel-vessel communications were done. For each one of the 3 items listed vertically to the left you check the appropriate box of the 4 options. For example, in this casualty, with regards to the vessel-vessel communications, did the vessels communicate using a VHF radio system? No, it was not used and it was not necessary.

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CASE 1: Bridge-Pilot Form, Side 1 only

Insert completed form, side 1

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CASE 1: Bridge-Pilot Form, Side 1 only

Insert completed form, side 1

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CASE 1: Crew-Crew Form, Side 2

Insert completed form, Side 2

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CASE 2 — Queen Elizabeth II

Summary:

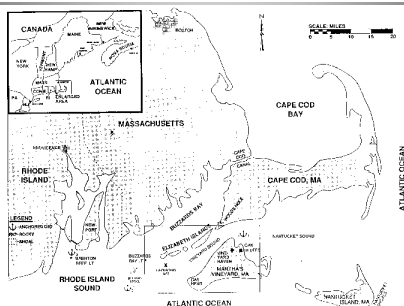
On August 7th 1992, the passenger vessel *RMS Queen Elizabeth II* was outbound in Vineyard Sound, Massachusetts, when the vessel grounded on a rocky shoal about 2.5 miles South of Cuttyhunk Island.

- » Weather was clear, visibility 10-15 miles, waterway calm with light winds
- » All propulsion, steering, and navigation equipment was functioning properly
- » \$13.2 million in damage, no deaths or injuries, no pollution

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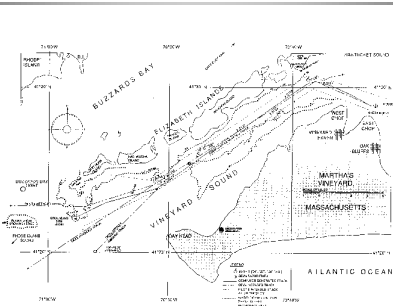
CASE 2 — Sketch of the Area, Accident Site



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CASE 2 — Sketch of the Area, Vessel's Track



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Case 2 — Event Timeline

Ship	2050 Lift anchor	2115 Round West Chop	2144 Pass NA buoy on heading of 235°	2150 Vessel steady on course of 250°	2158 Vessel aground
Pilot	2052 Set speed to 15 knots	2115 Increase speed to 18 knots	2124 Increase speed to 24 knots	2144 Change course from 235° to 250°	2154 Course changed to 240°
Master	2050 Turn vessel to proper heading and give com to pilot				2154 Requests (through FO) to pass further south of Sow & Pigs Reef

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CASE 2 — Communications Investigation - Pilot

Generic

- navigated this vessel before?
- navigated with this bridge crew or Master before?
- aware of master's intentions regarding the voyage?
- discussed his own passage planning intentions?
- aware of other crewmembers' actions?
- was a pilot card handed? was it necessary and adequate?

Casualty Specific

- did the pilot consult with the master regarding the ship's course for the outbound passage?
- did pilot and master discuss and approve changes in speed?
- did the pilot consult the ship's charts?
- did pilot discuss course changes with master?
- did pilot discuss disembarkation point?

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CASE 2 — Communications Investigation - Bridge Crew

Master

- navigated with this pilot before?
- always aware of pilot intentions and actions?
- discussed his passage planning intentions?

Bridge crew

- language difficulties between crewmembers and pilot?
- did pilot interact with crewmembers other than the Master (e.g., give orders to helmsman and/or officers)?
- were crewmembers aware of pilot's intentions?
- did they voice any disagreement or concerns to the pilot or other crewmembers?

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CASE 2 — Communications Investigation Topics

Generic

- 1) master pilot relationship
- 2) master's and pilot's pre-sailing conference
- 3) their manner & content of communications
- 4) their interaction with each other and with the bridge crew

Specific

- 1) the choice of tracklines, including courses and speed selected
- 2) the effects of decisions made by the pilot and the master about the ship's course
- 3) the master's and pilot's assumptions about the outbound track
- 4) the master's and pilot's knowledge of the extent of squat at high speeds

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CASE 2 — Findings

Communicated

- Master**
- asked the pilot about speed restrictions
 - asked the pilot if he objected to a speed increase to 24 knots
- Pilot**
- agreed to the speed increase
- Officers**
- 2ndO told 1stO who told Master of difference between actual ship's course and intended one
 - 1stO told pilot of Master's request for a course change
- Helmsman**
- no language difficulties
 - took orders directly from the pilot

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CASE 2 — Findings, cont.

Not Communicated

- Master**
- did not discuss or verify his choice of courses for the passage with the pilot
 - not aware of pilot's plan to alter course at the 'NA' buoy
 - (indirect communication): asked the 1stO to tell the pilot to change course, rather than telling the pilot himself
- Pilot**
- did not verify Master's voyage plan or navigator's charts
 - did not inform Master or crew of intention to alter course twice to his intended disembarkation point
 - did not discuss the course change with Master prior to changing course as requested by Master
 - did not tell the Master about the 39' sounding area
- Officers**
- 2ndO did not tell anyone that ship's new course was passing over 39' sounding area

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CASE 2 — Forms to Complete?

Casualty Screening Form	-->	Yes
Casualty Background Form	-->	Yes
Casualty Reporting Form		
» vessel-vessel	-->	No
» bridge-pilot	-->	Yes
» crew-crew	-->	Yes
» vessel-shore authority	-->	No
» vessel-shore workers	-->	No

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CASE 2 — Screening Form

Insert completed form

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CASE 2 — Casualty Background

Insert completed form

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CASE 2 : Bridge-Pilot Form, side 1

Insert completed form, side 1

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CASE 2: Bridge-Pilot Form, side 2

Insert completed form, side 2

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CASE 2: Crew-Crew Form, side 1

Insert completed form, side 1

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CASE 2: Crew-Crew Form, side 2

Insert completed form, side 2

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CASE 3 — Collision between Shinoussa & Chandy N

Summary:

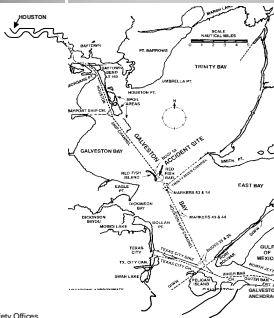
On July 28th 1990, at approximately 1440, the Greek tankship *Shinoussa* collided with a 3-tank barge tow being pushed by the US towboat *Chandy N* in the Houston Ship Channel in Galveston Bay, Texas.

- » Partly cloudy and visibility of 6 miles in light haze. Light winds and current at less than 1/3 knot.
- » All propulsion, steering, and navigation equipment was functioning properly.
- » \$1.7 million in damage, \$2.1 million in oil spill cleanup, no deaths or injuries.

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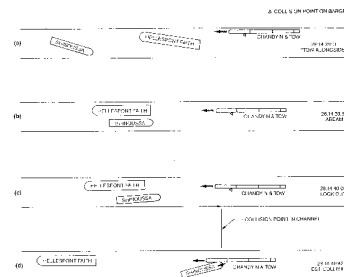
CASE 3 — Sketch of the Area, Accident Site



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CASE 3 — Sequence of Events



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CASE 3 — Investigation Planning

1. Review known facts
2. Determine what information is needed to find what happened & why
3. Assess if 'communications' could be an issue
4. Draft questions to pinpoint communications issues (if applicable)
5. Interview all individuals involved (at least once)
6. Review factual information & evidences
7. Complete investigation reporting forms
8. Send completed forms to Battelle

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CASE 3 — Interview Guidelines

- Who?
 - » People directly involved in the casualty
 - » People who may know while not being involved directly (e.g., safety officer)
- When?
 - » As soon as possible after the casualty, on site preferably
- Why?
 - » To obtain information that is not available on CG2692
 - » To verify facts & get detailed account of events
 - » To review individuals' actions or inactions
 - » To identify communication problems (if any) & contributing factors

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CASE 3 — Potential Persons of Interest

- This Casualty:
 - *Shinoussa's* Captain & Pilot
 - *Chandy N's* Operator
 - *Hellsport Faith's* Pilot
- In general, consider:
 - Individual listed in CG-2692's "Description of Casualty"
 - Individual who was injured
 - Individual supervising the injured person
 - Individual in charge of vessel activities
 - Witnesses or co-workers
 - Individual who committed the last action/decision prior to the casualty

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CASE 3 — Communications Interview Topics

1. Determine who you will talk to and why
2. Ask them to relate WHAT happened
3. Determine:
 - » individual's activities at time of casualty
 - » individual's frame of reference at time of casualty
 - » individual's decisions/actions/inactions at time of cas.
 - » individual's interactions with others (who, what, when, how, why)
 - » conditions under which the individual was operating

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CASE 3 — Communications Interview Topics, cont.

- Determine if communications were advisable
 - » What was the situation?
 - » Was the individual interacting with someone else? Should have individuals been communicating?
- Determine if there was a communications breakdown
 - » Did a communication take place?
 - » How was the information communicated?
 - » What information was communicated?
 - » When did communications take place?
 - » What means of communications was used?
 - » Were there any difficulties in transmitting the information?
 - » Was the communication interrupted?
 - » Was the information well-received, interpreted, and acted upon?

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CASE 3 — Communications Interview Topics, cont.

- Identify contributors to communications breakdowns
 - » Language difficulty?
 - » Problems with the communications equipment (e.g., malfunction, not available, turned off)?
 - » Communication affected by environmental factors (e.g., ambient noise, signal disruption, traffic)?
 - » Individual's procedures or actions undermine the communications (e.g., didn't have his radio, selected wrong channel)?
 - » Individual's mental model of the situation incorrect (i.e., individual made incorrect assumptions)?
 - » Individual's own job performance affected by various factors (e.g., tired, interrupted by other tasks)?

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CASE 3 — Communications Interview Topics, cont.

- Conclude by asking the individual:
 - » What contributed to the casualty and Why
 - » Was communications a contributing factor
 - » How communications was a factor
 - » Any safety recommendations to prevent similar occurrence

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CASE 3 — Role Playing

Instructors role play the interview or ask IOs what questions they would ask the *Shinoussa's* pilot.

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CASE 3 — Summary of Findings

- *Shinoussa*

- » Pilot's first time on board.
- » Master & pilot did not have a formal exchange before sailing.
- » No language difficulties between pilot and watch crew.
- » Pilot failed to report to 2 of 3 VTS reporting points.
- » Master & 2ndO questioned pilot about need for full speed.
- » Prior to collision, pilot was on the radio with *Chandy N*.
- » Last command prior to communication was 'Port 15'.
- » After radio communications, pilot ordered 'hard to starboard'.
- » Master & 2ndO recalled order but not hand signals.
- » Pilot informed *Chandy N* that there was nothing he could do.

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CASE 3 — Summary of Findings, cont.

- *Chandy N*

- » Operator reported to VTS as required.

- *Hellespont Faith*

- » Pilot had sailed on board this vessel numerous times.
- » Pilot and Master had a formal exchange of information.
- » Pilot reported to VTS as required, but did not mention speed.
- » No language difficulties between pilot and watch crew.
- » Pilot contacted the *Chandy N* on Ch.13 to arrange overtaking & to thank him after overtaking.
- » Pilot contacted *Shinoussa*'s pilot to inform him of overtaking but did not discuss a specific agreement to carry out meeting.
- » Pilot failed to ask the *Shinoussa*'s pilot for a speed reduction.

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CASE 3 — Forms to Complete?

Casualty Screening Form --> Yes

Casualty Background Form --> Yes

Casualty Reporting Form

- » vessel-vessel --> Yes
- » bridge-pilot --> Yes
- » crew-crew --> No
- » vessel-shore authority --> Yes
- » vessel-shore workers --> No

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CASE 3 — Screening Form

Include completed screening form

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CASE 3 — Casualty Background

Include completed Background form

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CASE 3: Vessel-Vessel Form, Side 1

Insert completed form (side 1 only)

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CASE 3: Vessel-Vessel Form, Side 2

Insert completed form (side 2)

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CASE 3: Bridge-Pilot Form, Side 1

Insert completed form (side 1 only)

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CASE 3: Bridge-Pilot Form, Side 2

Insert completed form (side 2)

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CASE 3: Bridge-Pilot Form, Side 2

Insert completed form (side 2)

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Next 10 Months

- | | |
|---|--------------------|
| • MSO training | August - Sept '97 |
| • Investigating & reporting | Sept '97 - Mar '98 |
| • Initial assessment | Oct-Nov '97 |
| • Wrap-up reporting | June '98 |
| • Final assessment & preliminary findings | April '98 |

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Your Role in the Next Month

1. Conduct communications investigation for vessel & personnel injuries (no pollution)
2. Contact Battelle with inputs regarding:
 - » data collection forms (format, questions)
 - » investigation and reporting procedures

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Project Schedule

1. One month assessment:
 - » Maintain contact with IOs
 - » Identify need to modify forms & procedures
2. Approximately 6-month data collection
3. Final evaluation of procedures
4. Research team provides feedback

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Reporting Package

- Each casualty reporting package should contain:
 - » *Casualty Screening Form*
 - » *Casualty Background Form*
 - » *Communications Reporting Form(s)*
 - » CG.2692
 - » MCIR & MCNS
- Collect all casualty reporting packages and send once a week

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How to Contact Us

- By phone/fax
 - » Marvin McCallum 206-528-3242
 - » Mireille Raby 206-528-3234
 - » fax 206-528-3552
- By mail
 - Battelle, HFTC
 - 4000 NE 41st Street
 - Seattle, WA, 98105-5428
- By e:mail
 - mccallum@battelle.org
 - raby@battelle.org

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